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INFORMATION – RESOURCES – ENERGY

CUTEC News

PRIZE FOR APPRENTICE

MERRY CHRISTMAS AND ALL THE BEST FOR 2014

Dear colleagues
and partners of CUTEC,

I would like to take this opportunity
to thank you all for your co-operation
and the trust you have placed in us
over the past year.

Merry Christmas and a happy
and successful new year
with best wishes from

your CUTEC team

ANALYSES OF RARE EARTH METALS

They are neither rare, nor are they earths, yet modern-day industrial society would be inconceivable without them: the 17 rare earth metals are essential in lighting up monitors and lasers, rotating wind turbines as well as racing bike wheels, and ensuring the permanent magnets on our tablet casings grip with a forceful click. New fields of application for rare earth metals are being opened up; a further rise in demand is to be expected. Consequently, the extraction and recycling of these now strategically important raw materials is becoming more and more important.

Coloured chemical compounds of some rare earth metals

Discovered in 1787 as oxides (in earlier times termed "earths"), the metals were long regarded as having no great practical use. Some of the metals found near the Swedish mine at Ytterby were named after it: yttrium, erbium, terbium and ytterbium. Some of the rare earth metals are so chemically similar that combinations of a number of them were initially not differentiated and – as in the case of erbium and terbium – actually swapped names as a result of being confused.

So chemical analysis remained very difficult until the second half of the 19th century. Exact separation of rare earth metals was often unfeasible. Only when Bunsen and Kirchhoff discovered spectroscopy did the breakthrough arrive. As similar as their chemical properties are, the visible light emitted by the atoms of rare earth metals when subjected to heat is individually characteristic. Spectroscopic analysis is still today the method of choice for qualitative and quantitative characterisation of rare earth metals.

Those familiar with the new organisational structure of the CUTEC Institute will be aware that rare earths are primarily the concern of the Department of Metal Recycling. However, the development of recycling processes first requires detailed knowledge of the metal content in the recycled materials.

Fusion in a platinum crucible

State-of-the-art ICP-OES spectrometer used by the Department of Chemical Analysis

This is where the Department of Chemical Analysis comes into its own. The first task is to manually separate the materials for analysis. In the present example the contents of a fuel cell electrode were to be determined. The separated anode material must be ground and turned into liquid form to enable spectroscopic analysis with the ICP-OES*. Normally this involves heating solids with strong mineral acids in a vessel by means of a microwave oven – wet decomposition, as chemists term the process. In the case of the anode material this proves to have little effect however; the solid material remains almost completely.

The most brutal method of chemical decomposition is then the most simple: solid fusion. The ground anode components are coated with a layer comprising multiple times the quantity of a mixture of borate and carbonate and heated in a platinum crucible. The Bunsen burner goes to work with a hissing blue flame, and a glowing red smelt is created. It takes almost an hour in this magic fire for all the constituents to be separated out from their existing structure. Then the solidified fusion cake can be dissolved with diluted hydrochloric acid and thus be spectroscopically analysed. By this method not the smallest grain of rare earth metal escapes precise analysis.

With the aid of this and other newly developed analytical methods we hope soon to be able to analyse the rare earth metals in all kinds of everyday items used by our industrial society. And where it is worth doing, we will recover them! (fi)

*ICP-OES: inductively coupled plasma optical emission spectrometry

ESTABLISHMENT OF THE INSTITUTE OF ELECTRIC POWER ENGINEERING AND ENERGY SYSTEMS

Prof. Faulstich (l.) and Prof. Beck in front of the new institute sign

The chair of Environmental and Energy Technology headed by Prof. Faulstich is located at the Institute of Electric Power Engineering and Energy Systems at Clausthal University of Technology (TU Clausthal).

The Clausthal Institute of Environmental Technology (CUTEC), the TU Clausthal and the Lower Saxony Energy Research Centre EFZN will further enhance their existing close co-operation to undertake joint research and teaching in the field of energy systems. As part of those developments, the existing Institute of Electric Power Engineering has been expanded to form the Institute of Electric Power Engineering and Energy Systems. The Faculty of Energy and Economic Sciences and the Presidium and Senate of the University have unanimously approved this future-oriented step.

On October 22nd, 2013 Prof. Faulstich introduced himself to the staff of the existing Institute of Electric Power Engineering. This was the occasion on which the photograph showing him together with Prof. Beck in front of the sign for the new Institute was taken.

The objective of bundling the resources in energy research is to enhance the visibility of the research facility and to develop energy as a focus of teaching and research.

The latest report from the UN's Intergovernmental Panel on Climate Change (IPCC) has once again highlighted the fact that global climate change necessitates a shift away from the use of fossil fuels as energy sources. That shift in energy use is also a key concern of Professors Beck and Faulstich. In the long term, all areas of industrial society will have to be shifted to renewable energy sources. Renewables already account for around 25 % of total electricity generation. A similar transformation process also needs to take place on the heat and cold generating market, as well as in primary materials production. The expanded institute will research and implement topics in the context of the shift in energy policy based on concrete projects. Transport systems such as railways, cars and motorbikes, trucks and buses can be powered by regenerative electric power, as can some areas of the primary materials industry including electrosteel production and aluminium electrolysis. By contrast, ships and aircraft as well as many other areas of the primary materials industry (metallurgical reduction, chemicals, building materials) will probably still have to rely further on gaseous or liquid energy sources (hydrogen, hydrocarbons) in the long term. They can in principle likewise be produced by conversion methods from regenerative electric power – firstly by conversion directly into hydrogen using electrolysis and secondly by further reaction with carbon dioxide from biomass or by industrial processes to produce hydrocarbons.

Hence, in the future energy system the electric and material-based methods of generation will grow more closely together, and will have to be viewed as a unified whole. This, too, was one of the motives for bundling the necessary research and teaching activities in one institute, and to underline the move within the institute's new name. (zh)

PROJECT MEETING IN BRAZIL

In October 2013 Dr. Zeller and Mr. Sauter from the Department of Metal Recycling visited research partner ULBRA (Universidade Luterana do Brasil) in Canoas in the Brazilian state of Rio Grande do Sul.

They undertook intensive consultations with Prof. Dr. Erwin Tochtrop and Dr. Ester Schmidt-Rieder on the IEPALT project.

The technical objective of the IEPALT project is for the first time to
develop a process which permits residue-free recycling of the complete Spent Pot Liner (SPL, cathode carbon and refractory clay) from primary aluminium extraction reactors.

The IEPALT project is attracting major interest from the aluminium industry worldwide, because there have to date been no convincing methods for the disposal or recycling of spent pot lining. In the scientific sphere, too, Brazil is demonstrating an increasing commitment by involving an additional partner, namely the renowned UFRGS (Universidade Federal do Rio Grande do Sul).

The trip also focused on organisational preparations for the visit by Dr. Mennicken from the German Federal Ministry of Education and Research (BMBF) and Ms. Hauschild from the project funding organisation Jülich.

The Department of Metal Recycling is once again demonstrating that it is capable of sustainably planning, organising and executing successful projects particularly on the international stage. (ze)

TRAINING OF A NIGERIAN DELEGATION AT THE CUTEC INSTITUTE, GERMANY

A photograph was taken before the course

In November 2013, a 10-man delegation from Nigeria underwent training at the CUTEC Institute in Germany. The participants came from various government institutions in the capital of Niger State, Minna.

The training which was titled "Integrated water and waste water treatment technologies" lasted for two weeks. On arrival at CUTEC, the delegation which was headed by Arc. Bawa, Permanent Secretary of the Niger State Ministry of Environment, Parks, Garden and Forestry, was personally welcomed by Prof. Faulstich. In his welcome speech, Prof. Faulstich mentioned how pleased he was to see such a collaborative undertaking and expressed the wish that the participants would be able to put into practice much of what they learnt from the course back home in Nigeria. He then gave a presentation on the Institute and its activities.

In the first week the Nigerian delegation attended a number of experimental workshops and a wide range of lectures presented by the Institute's experts and industrial partners. The Institute's officers included Prof. Sievers, Dr. Onyeche, Dipl.-Ing. Bormann, Dipl.-Ing. Niedermeiser and M. Sc. Pastagiya from the Department of Waste Water Process Engineering, Dr. Fischer from the Department of Chemical Analysis and Dr. Zeller from the Department of Metal Recycling.

The second week was mainly for excursions at various environmental facilities in Northern Germany, including waste water treatment plants and biogas plants. The tour was accompanied by Dr. Onyeche, who had also designed the programme and organised the training course. As practicedsed in previous training courses, the delegation paid a courtesy viste at the Nigerian embassy in Berlin to provide the forum for interaction with the ambassador and his staff on the training at CUTEC and the necessary application of the knowledge in Nigeria.

Four of the ten participants had also attended the first course last year on Solid Waste management and landfill development. Both courses are part of a five-year consulting contract signed last year between the government of Niger State and the CUTEC team. The photograph shows the members of the Nigerian delegation with Prof. Faulstich and some of his

STATE OF LOWER SAXONY ENERGY CONFERENCE IN GOSLAR

The sixth State of Lower Saxony Energy Conference (net2013) hosted on October 16th and 17th, 2013 by the Lower Saxony Energy Research Centre EFZN was held under the motto "Changing everyday energy use – What needs to be done?" The event provided the opportunity for more than 250 representatives from industry, science and the political world to engage in dialogue.

The first day began with a presentation of the position paper "Energy policy change 2.0" by Dr. Christian Jacobs from the state government of Lower Saxony. Others speakers in the course of the conference were Dr. Udo Niehage (Siemens AG), Matthias Brückmann (EWE AG) and Dr. Volker Müller (UVN e.V.), who set forth their views on the challenges posed by the reversal of Germany's energy policy. In the concluding contribution, Prof. Martin Faulstich spoke on "Prospects for a new electricity market design", including a presentation of the benchmark paper "Shaping the Electricity Market of the Future" produced by the German Advisory Council on the Environment SRU. The paper considers how the electricity market can be reshaped, taking into account both current challenges and the long-term goal of obtaining electricity supply from renewable sources as far as possible. Prof. Dr. Michael Jischa from the Club of Rome opened the evening event with his presentation titled "The end of the world as we knew it".

The second day comprised five technical forums on the subjects of energy policy change; offshore; storage; geothermal energy; and gas networks and integration of renewables. As part of the last-named forum, Prof. Dr. Martin Faulstich gave a presentation on the subject of "A sustainable primary materials industry". In it, he used the example of cement production to demonstrate that it will in future be technically possible to eliminate fossil fuels completely as energy sources even for the primary materials industry. (zh, kr)

Prof. Faulstich during his presentation on the second day of the event

VISIT OF THE "GREEN TALENTS" TO THE CUTEC INSTITUTE

Group photo of the participants in front of the CUTEC Institute

On October 31st, the 25 winners of this year's "Green Talents" ecological sustainability competition visited the CUTEC Institute as part of their two-week tour of selected research institutions around Germany. They were accompanied by a three-person camera team and two representatives of the project funding organisation DLR (the German national aeronautics and space research centre).

Following a word of welcome and a presentation of the Institute by Prof. Faulstich, the prize-winners from 18 countries and several continents were divided into two groups to tour the laboratories and pilot plant halls. The tour focused on six selected key areas of the Institute's research work, each profiled by a different member of staff. At the various points around the tour the "Green Talents" also had the opportunity to ask questions or discuss particular aspects of the specific plant with the assigned staff member. The international group representing the scientists of tomorrow made extensive use of both options. The topics covered by the six stations toured ranged from biomass conversion, through the production of fuels and chemical raw materials and the generation of biogas from biomass, to the award-winning process for the dezincification of steel sheet.

The participants saw various research installations on their tour

On returning to the seminar room after the tour, the two groups were reunited to receive two detailed presentations on the research topics of fuel cells and metal recycling.

The dinner in the evening offered the "Green Talents" the opportunity to engage in more extensive discussion with all the Institute staff attending the event. After a parting speech from Prof. Faulstich, the group boarded the coach to continue their tour, heading for Geesthacht, where the next day they visited the research centre there.

The official ceremony at which the award-winners were presented with their certificates was held as the culmination of the tour on November 8th in Berlin. As well as enjoying this year's two-week tour of Germany, the award-winners will next year be able to spend a period of up to three months carrying out research at an institution of their choice in Germany.

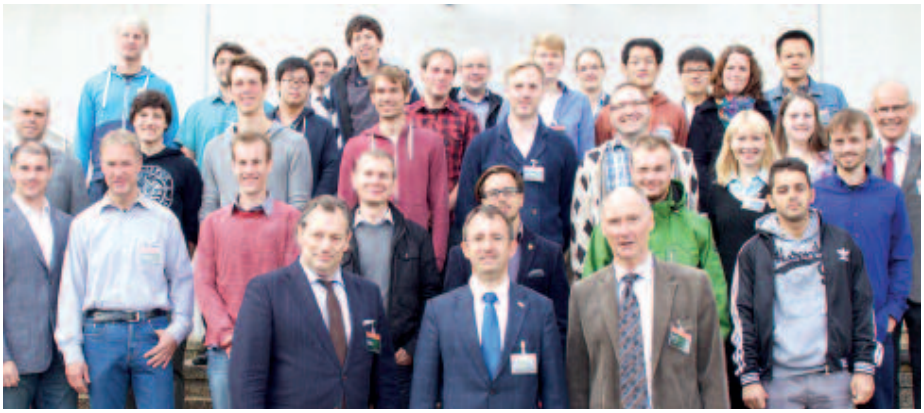
The 2013 "Green Talents" competition was launched on April 30th. This year the Institute has in fact been supporting it in two ways: firstly, as described, by hosting a tour by the 25 award-winning young scientists; and secondly, by Prof. Faulstich's membership of the ecological sustainability competition's prize-awarding jury.

More than 430 applications from 80 countries were received in 2013, all vying to be voted the "Green Talents" of the year by the four-member jury.

The scientists' technical discussions were highly complex

Officially titled "Green Talents – International Forum for High Potentials in Sustainable Development", this competition organised by the German Federal Ministry of Education and Research (BMBF) to recognise outstanding young international scientists is already marking its fifth year. Applicants must not be more than 32 years old, and must not live in Germany. (he)

SIXTH STATE OF LOWER SAXONY FUEL CELL SUMMER SCHOOL IN GOSLAR



The participants and hosts in front of the EFZN

Having once again bid successfully to be appointed by the State of Lower Saxony Ministry of Trade and Industry, Employment and Transport to organise the "Innovation Summer School 2013", CUTEC was able to host what was the sixth Fuel Cell Summer School to be held in Lower Saxony. The event took place from September 16th to 19th at the Energy Research Centre (EFZN) of the TU Clausthal in Goslar. The participants included undergraduate and doctoral students from Lower Saxony as well as students from Berlin and from the states of Mecklenburg-Western Pomerania, Saxony and Saxony-Anhalt. Following a welcome from Prof. Faulstich, lectures by scientists from the host institutions included tuition on the scientific fundamentals of fuel cells and battery technology, from electrochemistry through thermodynamics, materials and components, to complete systems.

Other presentations considered the essential conclusions to be drawn from the shift in German energy policy. Thereafter, the applications and issues confronting industry in Lower Saxony were set forth.
Practical exercises also helped the participants understand the topics more fully, with CUTEC organising a range of fuel cell related exercises and the Institute of Chemical Process Engineering organising exercises relating to battery technology. The tuition was supplemented by an excursion to the Volkswagen Technology Centre in Isenbüttel, where the application of fuel cells and of battery technology was demonstrated, and an opportunity was provided also to discuss the future of electromobility.

At the end of the event, each participant was in a position to answer the question: Can fuel cell and battery technology offer me a future career specialisation? This event demonstrated the exemplary role being played by the State of Lower Saxony in providing young academics with tuition on key subjects of vital importance to future energy policy, and enabling intensive interchange with science and industry.

The participants were all thoroughly delighted as they looked back at a week packed with lectures, practical exercises, discussions and excursions: "Learned a lot ... Great teaching of the basics ... Made some valuable contacts with industry ... Heard some fascinating lectures ... Got to know some outstanding experts from many different fields ... Nice accommodation ... Superb conference folder with documentation from all the lectures...".

The Fuel Cell Summer School was again generously supported by industry representatives from the State Energy Storage and Systems Initiative, namely Dow Deutschland Anlagengesellschaft mbH, EWE AG, H.C. Starck GmbH and Volkswagen AG, as well as by the regional universities in Braunschweig and Clausthal and the Hochschule Ostfalia college in Wolfsburg.

The subsequent second Summer School at the EFZN on the subject of "Energy storage and systems" marked the beginning of a long-term co-operation between CUTEC and the EFZN. In future there will be an annual Summer School on fuel cell and battery technology and a Winter School on energy storage and systems, all supported in the tried and proven manner by industry and academic institutions in Lower Saxony. (di)

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PRIZE FOR CUTEC APPRENTICE

At a ceremony held in Goslar on November 5th, Daniel Gröters was presented with this year's Merit Prize awarded by the Goslar industrial association "Industrieverein Goslar von 1920 e. V.". The prize was awarded not only in recognition of his outstanding performance in qualifying as an industrial mechanic this year, but also for his personal commitment both in practical training and at vocational college. We wish Daniel all the best for his future. (he)

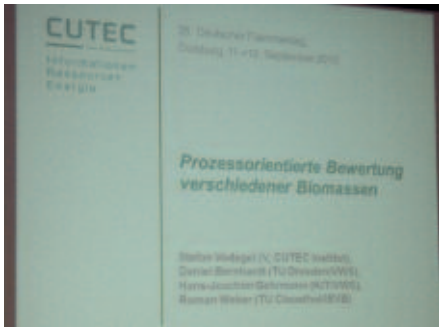
Mr. Johann-Friedrich Weule, Mr. Daniel Gröters, Mr. Ralf Bauer and Mr. Markus Lenk (left to right)

REPRESENTING CUTEC

GERMAN FLAME DAY

Dr. Vodegel during his presentation

Every two years, experts in thermo-chemical conversion gather to interchange news, views and information. Their focus is on scientific topics relating to combustion. Prof. Görner from the Gesamthochschule Duisburg-Essen college has been Scientific Director for a number of years, and was again this year the host of the event. The "German Flame Day" conference held on September 11th and 12th again proved very popular, attracting some 250 participants. Dr. Vodegel contributed a presentation on the subject of "Process-oriented assessment of biomasses". His findings originated from a joint project of the same name involving the KIT Institute of Technical Chemistry, the TU Dresden Chair of Combustion, Heat and Material Exchange, and the TU Clausthal Institute of Energy Process Engineering and Fuel Technology. The large audience discovered the state of the art of German biomass plants as well as being presented with findings on the thermal behaviour of various biomasses compared to lignite. (vo)



Opening slide of Dr. Vodegel's presentation

23RD WORLD MINING CONGRESS

The World Mining Congress was held in Montreal, Canada, from August 11th to 15th, attended by some 1,500 international participants. A parallel exhibition saw 300 companies presenting their products and services in the fields of mining, automation, robotics and design.

The CUTEC Institute was represented at the congress by the head of the Department of Metal Recycling, Dr. Zeller, and his deputy, Mr. Sauter.

Group photo in front of the congress venue

Dr. Zeller gave a presentation on "Landfill mining as demonstrated by the example of mining and metallurgical tips in the Harz Mountains, Lower Saxony, Germany". In the course of the event contacts potentially leading to scientific co-operation were established, including with representatives from Poland and Australia, and those leads will be followed-up by the Department of Metal Recycling. Dr. Zeller was also co-chair of the session titled "Novel alternatives in waste management".

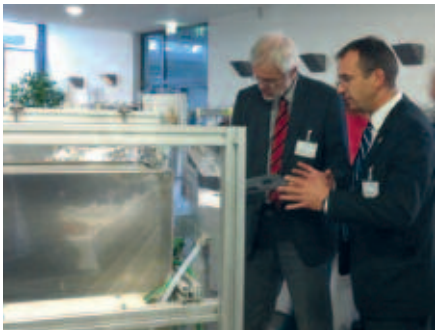
Pictured: A small Canadian-German summit in the course of the 23rd World Mining Congress in Montreal to discuss potential for co-operation (left to right): M. Sc. C. Schmidt (Canadian German Chamber of Industry and Commerce Inc.), Dipl.-Ing. W. Roehl (BG RCI), Prof. K. G. van den Boogaart (Helmholtz Institute Freiberg), Dr. A. Gryska (Mine Rescue Ottawa), Dr. R. Tolosana Delgado (Helmholtz Institute Freiberg), Dr. T. Zeller (CUTEC), Dipl.-Kfm. A. Sauter (CUTEC). (ze)

SECOND LOWER SAXONY FORUM ON ENERGY STORAGE AND SYSTEMS

On November 6th, Solvay GmbH in Hanover hosted the second Lower Saxony Forum on Energy Storage and Systems. Keynote topics of this year's event organised by the State Energy Storage and Systems Initiative were hydrogen as an energy store, electrochemical energy stores, smart grids and power-to-gas processes. Alongside overview presentations relating to storage technologies, presentations also featured specific projects such as the construction of a 6 MW power-to-gas pilot plant at Werlte in Lower Saxony.

The approximately 140 participants were also able to discover the strengths and competencies of Lower Saxony's industry and research institutions in an accompanying exhibition. In a podium discussion moderated by Dr. Stefan Franzke (Innovatives Niedersachsen GmbH), a panel comprising Annegret Agricola (dena), Dr. Jörg Hermsmeier (EWE AG), Mathias Timm (BEDW), Christian Schwarzenholz (Lower Saxony Ministry of the Environment, Energy and Climate Protection) and Dr. Wedigo von Wedel (NEXT ENERGY) debated the current state of technical developments, options for future action and potential solutions.

At the forum, CUTEC exhibited a 1 kW SOFC fuel cell system for high-efficiency power generation from propane. Dr. Dietrich and Dr. Lindermeir took the opportunity during breaks to talk about CUTEC's energy storage related activities with some familiar and some new partners from the scientific, industrial and political spheres. (li)



Dr. Dietrich (right) explains the SOFC fuel cell system

FOLLOW-UP TO THE GERMAN SCIENCE DAYS IN KYOTO

On October 25th and 26th, 2013 the German Science and Innovation House in Tokyo hosted the "German Science Days" event in Kyoto.

The object of the event was to promote German-Japanese exchange in teaching and research, and to provide students and young scientists at the universities of the Kansai region with the opportunity to find out all about Germany as a centre of research and innovation by means of personal contact.

In pursuit of those ends, the two-day event featured presentations by leading German universities, research institutions, companies and scientific organisations, who set up dedicated information stands where visitors could put questions to the attending staff and establish contacts with the exhibiting organisations. At the opening symposium, titled "Research for sustainable development", the German Ambassador Dr. Volker Stanzel, the Mayor of Kyoto Daisaku Kadokawa and the President of the German University Rectors' Conference Prof. Horst Hippler spoke to welcome the participants.

Following introductory presentations by Prof. Kazuhiko Takeuchi, Vice-President of the United Nations University, and Prof. Martin Faulstich, Managing Director of the CUTEC Institute and Chairman of the German Advisory Council on the Environment, the German-Japanese panel discussed the responsibility of science and industry to assure sustainable development. (he)

Prof. Faulstich during the discussion

SOAM PROJECT: TEST SAILING ON THE BALTIC

The SOAM project is concerned with the automatic detection of spent ammunition in the North Sea and the Baltic. As part of the project, the Department of Model-Based Systems Analysis is working on the development of software to evaluate the data acquired. In order to experience in person just how the data is collected, two members of CUTEC staff were assigned to join a test sailing scheduled to operate from October 10th to 16th, 2013. Stela Moçka and Bernd Nawothnig were the CUTEC representives. The equipment needed for the trip was loaded onto the ship at the port of the naval arsenal in Kiel. The equipment included a tow-line attached Benthos sonar unit, which in turn pulled a magnetic probe connected by an additional cable. To be able to localise the positions of the sensors precisely, a so-called track-point was extended approximately two metres beneath the keel by way of the deploying shaft located amidships. The track-point then communicated with the towed sonar unit by way of an underwater modem to determine its position. Sensors installed on-board the ship were also used. These consisted of a multi-beam echo-sounder and a sediment echo-sounder. The sediment echo-sounder is capable of detecting objects hidden beneath the sea bed.

Research ship "Elisabeth Mann Borgese"

The weather report on the day prior to sailing was not good, but since the trip had been firmly scheduled, as evening approached we left port heading towards Neustadt Bay, where we intended to detect a number of known dummy mines which had been sunk for the purpose some years previously. The wind then freshened strongly, as the weather report had predicted, reaching force 7 - 8, and resulting in a 6 - 7 swell. The waves were now regularly washing over the afterdeck, and often reached half-way up the portholes of the laboratory where the computers were installed. Deploying the towed sonar unit in such seas was unthinkable, and after the measurements of the multi-beam echo-sounder also became obviously corrupted by the large number of bubbles being generated under the bow by the ship's pitching, during the afternoon the captain decided to abort the measurements for the time being and headed for port in Neustadt. The weather report for the following days looked better, so the next day we headed out again, and despite the still heavy swell, we were able not only to resume the measurements but also to deploy the towed sonar.

By the time the measurements were complete, a large volume of data had been obtained, which we have since been analysing. (na)

IMPRINT

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